Training the creative process

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Overview and Statement of the Problem

Organizations consider training and development an important part of their employees' careers. Proper training fosters competent and competitive employees. Training may increase employees' satisfaction with work because they are more knowledgeable and confident when performing their job duties (Goldstein, 1991). In addition, training may increase employees' productivity levels because they have the necessary knowledge and skills needed to perform their jobs and therefore, will perform their jobs well.

Although there are many aspects of one's job that might benefit from training, one crucial component of most jobs is problem-solving or decision-making performance. Specifically, employees are expected to solve problems effectively in a variety of situations. To be effective at solving problems in a plethora of situations, organizations have discovered the importance of creative problem solving. How does an organization maximize its potential for creative problem solving? Organizations might wish to hire creative individuals; however, utilizing the current employees is more feasible than hiring a new workforce. Can an organization realistically expect to train their employees to be creative? The study to be described attempted to provide a preliminary answer to this question

Training Creativity

Many researchers believe that creativity can be enhanced or trained (e.g., Amabile, 1983; Cropley, 1997; Guilford & Tenopyr, 1968; Nickerson, 1999; Torrence, 1972). Although the theories underlying different researchers' beliefs about increasing creativity may differ, all agree that for creativity to materialize, knowledge, strategies or skills, motivation, and personal attributes all play a role.

Brophy (1998) expounded a unifying theory of creative problem solving. He stressed that ill-defined problems differ in the level of complexity, the knowledge needed, and the amount of divergent and convergent thinking needed, and therefore, individuals need different preferences and abilities that best match the problem. In addition to an essential divergent/convergent thought component, Brophy (1998) suggested that level of metacognition and level of self efficacy might differentiate creative and not creative problem solvers. Problem solvers who are aware of their cognitive processes and who feel confident in their ability to solve problems may have an easier time accessing relevant schemas and strategies for solving novel problems, which in turn would lead to more creative solutions. Research has suggested that both metacognition (e.g., Armbruster, 1989; Masuri & DeCorte, 1999; Ridley, Schutz, Glanz, & Weinstein, 1992;) and self-efficacy (e.g., Martocchio, 1994; Mathieu, Martineau, & Tannenbaum, 1993; Saks, 1995; Wege & Moller, 1995;) are related to creativity and training issues. These variables were included in the present study.

Brophy (1998) stated that even though individuals may prefer one stage of creative problem solving over another, they can be trained to understand other abilities, thinking strategies, and processes essential to creative problem solving. Similarly, Cropley (1997) stated that to foster creativity, it is important to extend one’s existing knowledge structure and to build unique ways or strategies of seeing the world. If Brophy and Cropley are correct, then informing individuals about different thinking strategies, instructing them on when to use these strategies, and allowing them to practice the strategies may improve their creative problem-solving performance.

Rose and Lin (1984) performed a meta-analysis of creativity training programs. The authors claimed that different training methods seem to affect differently creativity. The results of the meta-analysis suggested three main conclusions. First, overall, creativity training appeared to be successful for improving creativity as measured by the Torrance Tests of Creative Thinking (TTCT). Overall, creativity training accounted for 22% of the variance in participants' overall creative-thinking performance. Second, different training methods resulted in different effect sizes. For example, a moderate effect size was found for research using the Osborn-Parnes' Creative Problem Solving Program; however, a small effect size was found for research using the Covington's Productive Thinking Program. Third, different training methods differentially explained variance in the two components of TTCT, verbal and figural. Overall, training affected verbal creativity more than figural creativity.

Despite these finding, Rose and Lin (1984) suggested that not much is known about the effectiveness of creativity training. They alleged that locating empirical studies that assessed the effectiveness of creativity training was difficult. In addition, due to problems with the calculated effect sizes of some of the training methods examined in the meta-analysis (effect sizes over 1), interpretations should be made cautiously. In addition, it should be noted that the TTCT measure chosen as a criterion for a study's inclusion in the meta-analysis is a measure of divergent thinking or idea generation. Although the solutions participants generate are often rated on various components of divergent thinking, the test is assessing divergent thinking only and not overall creative performance. Divergent thinking is only one component of the creative process. Unfortunately, most of the creativity training found in the literature has focused on divergent thinking (e.g., Basadur & Finkbeiner, 1985; Basadur, Graen, & Green, 1982; Basadur, Wakabayashi, & Graen, 1990; Clapham, 1997; Fontenot, 1993) There are other creativity components within each problem-solving stage aside from ideation-evaluation that have not been considered. One study was found in the literature in which a different stage of the creative problem-solving process was trained. Clinton and Torrance (1986) trained a group of instructional supervisors in problem identification. The problem-identification training resulted in more comprehensive problem restatements and supports the notion that another component of the creative process, problem identification, can be trained.

To add to creativity training research, the present research included strategies from multiple stages of the creative problem-solving process (Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991). Four stages were included: (a) problem construction, (b) category combination/reorganization, (c) alternative generation, and (d) alternative evaluation. In addition, little attention has been given to the method of administering the training such that learning is optimized. From the descriptions found in the reviewed studies, all of the researchers used a knowledge component, and most used some type of practice exercise. Although including both of these components is typical in training (Goldstein, 1993; Kraiger, Ford, & Salas, 1993; Wexley & Latham, 1991), it is not known whether both are necessary for optimal training in creativity. The present study will examine levels of knowledge and practice within training sessions.

Hypothesis 1: Individuals receiving training in creative problem solving will receive higher creativity ratings than will individuals not receiving training in creative problem solving.

Hypothesis 2: Individuals receiving both knowledge of and practice with creative problem-solving strategies will receive higher creativity ratings than will individuals receiving knowledge-only, practice-only, or no creative problem-solving training.

Method

Participants

There were 118 students who completed the training. The average age was 25 years (SD = 6), and participants were distributed across number of years in school: 18.6% first year, 11.9% second year, 26.3% third year, 16.9% fourth year, 6.8% fifth year, and 19.5% other. Females accounted for 63.6% of the participants in the sample.

Computer Training Program

The investigator designed two programs for this research. The first program was given to the control group and presented information and practice questions regarding employment interviewing. The second program was the creative problem-solving training. The creative problem-solving training program provided information (knowledge), practice problems (practice), or both (knowledge and practice) for the creative problem-solving process. The program contained basic knowledge about creative problem solving and more specific knowledge on effective strategies used in problem solving. In addition, the program provided designated groups of participants with practice tasks in applying the strategies.

Although many individual difference variables are important to training, two variables expected to relate to creative problem-solving training were included and used as covariates, self-efficacy and metacognitive awareness. Scores on the self-efficacy measure (Chen, Gully & Eden, 2001) ranged from 10 to 40 with an average self-efficacy score of 39.94 (SD = 4.24). The internal consistency of the measure was .91. The present study found an alpha of .91 for the metacognitive awareness measure (Schraw & Dennison, 1994). The range of scores was 113 to

256 with a mean of 193.90 (SD = 18.41).

Dependent Measures

Overall creative problem-solving task. Ill-defined, real-world problems were used to measure overall creative problem-solving performance. Participants were asked to solve one ill-defined, real-world problem for the pretest and one for the posttest. The problem solutions were rated on quality and originality, two components considered essential for creativity (Amabile, 1983; Mumford & Gustafson, 1988). Quality was defined as the degree to which a solution solves the problem and is feasible, practical, and appropriate. Originality was defined as the degree to which a solution is unique, imaginative, and not structured by the problem. The definitions of quality and originality were adapted from Redmond, Mumford and Teach (1993) and Reiter-Palmon, Mumford, O'Conner Boes, and Runco (1997). Graduate students in the Industrial/Organizational Psychology graduate program served as raters to determine whether or not the problem solutions were useful and unique. Two raters were used for both components of creativity. Gender and rating experience were equated for pretest and posttest ratings. Large disagreements between the two raters were discussed until a consensus was reached (Pretest Quality alpha = .98; Pretest Originality alpha = .96; Posttest Quality = .78; Posttest Originality = .80). Average ratings were calculated and used in all analyses. The average ratings on the pretest problem were 2.14 (SD = 1.19) for quality and 2.42 (SD = 1.13) for originality. On the posttest problem, average ratings were 2.89 (SD = 1.12) for quality and 3.21 (SD = 1.13) for originality.

Results

As Table 1 displays, Pretest Solution Creativity was significantly correlated with Posttest Solution Creativity ($r = .40$, $p < .05$) and Pretest Solution Quality was significantly correlated with Posttest Solution Quality ($r = .51$, $p < .05$), indicating that individuals who received high creativity and high quality ratings before training also received high ratings after training. Pretest Solution Originality was not significantly correlated with Posttest Solution Originality ($r = .11$, ns). Pretest Solution Quality and Pretest Solution Originality were correlated ($r = .46$, $p < .05$) as were Posttest Solution Quality and Posttest Solution Originality ($r = .58$, $p < .05$), indicating that individuals who received high quality ratings also receive high originality ratings on their problem solutions. The two main covariates, metacognitive awareness and self-efficacy were not significantly correlated with the dependent measures (Table 2). The correlation between metacognitive awareness and self-efficacy was significant ($r = .51$, $p < .05$).

Training Versus No Training

The first set of analyses examined whether the training program resulted in improved performance on a problem-solving task. Covariates were retained in the analyses if their inclusion helped in the prediction of the dependent variable, even if their individual F value was not statistically significant. Potential covariates included all pretest variables, metacognitive awareness, and self-efficacy.

Overall solution creativity. There was a statistically significant pretest difference in overall solution creativity between the Training and No Training groups. On average, individuals in the Training group received higher pretest solution creativity ratings ($M = 2.40$) than did individuals in the No Training group ($M = 1.88$), $F(1,113) = 6.43$, $p < .05$. In addition to the pretest solution creativity, metacognitive awareness and self-efficacy were also used as covariates. Results showed a statistically significant posttest difference in overall posttest solution creativity between the Training and No Training groups, $F(1,113) = 6.49$, $p < .05$ (Table

3). Individuals who received creative problem-solving (CPS) training received higher mean solution creativity ratings than did individuals who did not receive CPS training.

Solution quality. There was a statistically significant difference in pretest quality ratings between the Training and No Training groups. On average, individuals in the Training group received higher pretest solution quality ratings (M = 2.30) than did individuals in the no training group (M = 1.62), $F(1,113) = 7.60$, $p < .05$. Using pretest quality, metacognitive awareness and self-efficacy as covariates, there was a statistically significant posttest difference in solution quality between the Training and No Training groups, $F(1,113) = 6.02$, $p < .05$. Individuals who received CPS training received higher mean solution quality ratings than did individuals who did not receive CPS training (Table 4).

Solution originality. There was no statistically significant difference in pretest solution originality ratings. Using pretest solution originality, metacognitive awareness, and self-efficacy as covariates, a statistically significant difference was found for posttest solution originality, $F(1, 113) = 4.65$, $p<.05$. Individuals who received CPS training received higher originality ratings than did individuals who did not receive CPS training (Table 5).

Knowledge and Practice Versus Knowledge Versus Practice Versus Control

The second set of analyses examined whether using knowledge about and practice of (KP) creative problem-solving strategies resulted in better posttest performance on a problem-solving task than using only knowledge (K) about creative problem solving strategies, only practice (P) of creative problem solving strategies, or neither (Control).

Overall solution creativity. There was no statistically significant pretest difference in overall solution creativity among the Knowledge and Practice (M = 2.41), Knowledge Only (M

= 2.28), Practice Only (M = 2.52), and Control (M = 1.88) groups. In addition to pretest solution creativity, metacognitive awareness and self-efficacy were also used as covariates. As can be seen in Table 6, there was a marginal mean difference in posttest solution creativity among groups, $F(3, 111) = 2.31$, $p = .08$. Although the overall F did not reach the .05 level, pairwise comparisons showed that the Knowledge and Practice group and the Knowledge Only group received higher posttest solution creativity ratings than did the Control group (Table 7). Also, there was a marginal difference between the Practice Only group and the Control group ($p = .094$), indicating that the Practice Only group received higher solution creativity ratings than did the Control group.

Solution quality. There was a statistically significant difference in pretest quality ratings among the Knowledge and Practice (M = 2.17), Knowledge Only (M = 2.23), Practice Only (M = 2.50), and Control (M = 1.62) groups. Pretest quality, metacognitive awareness, and self-efficacy were used as covariates. As Table 8 displays, there was a marginal mean difference in posttest solution quality across groups, $F(3, 111) = 2.22$, $p = .09$. Group means are provided in Table 9. Individuals who received Knowledge Only training received statistically significantly higher posttest solution quality ratings than did individuals in the Control group. Both the Knowledge and Practice ($p=.088$) and the Practice Only ($p = .066$) groups showed marginal gains over the Control group.

Solution originality. There was no statistically significant difference in pretest solution originality (KP M = 2.66, K M = 2.33, P M = 2.53, Control M = 2.14). Pretest solution originality, metacognitive awareness, and self- efficacy were used as covariates. The overall difference across groups for posttest solution originality was not statistically significant, ($F(3,$

11) = 2.34, ns (Table 10). Despite the lack of overall significance, comparisons showed that individuals in the Knowledge and Practice condition received statistically significantly higher originality ratings than did individuals in the Control group (Table 11). Also, there was a marginal mean difference between the Knowledge Only and Control groups ($p = .083$). Individuals who received knowledge about creative problem solving, which included knowledge about originality as a factor of creativity, received the highest originality scores on posttest problem solutions.

Overall, the results for the KP versus K versus P versus Control analyses display differences among conditions for each of the dependent measures. Surprisingly, the Knowledge Only group outperformed most other groups. Of particular note is that the Knowledge Only group performed significantly better than the Knowledge and Practice group, which is contrary to expectations. Knowledge appears to be an essential component for improving performance in creative problem solving.

Discussion

The present study examined the effectiveness of a computer-based training program to improve creative problem-solving skills. It was predicted that training in creative problem solving would lead to improved performance on an unstructured problem-solving task. Overall, the Training versus No Training hypothesis was supported. Across dependent measures, individuals who received CPS training received higher creativity ratings on a creative problem-solving task than did individuals who did not receive CPS training.

For the Knowledge and Practice versus Knowledge Only versus Practice Only, both the Knowledge and Practice and Knowledge Only groups performed better than did the Control group on solution creativity and solution originality. The Practice Only group had marginally higher mean creativity and higher mean originality ratings than did the Control group. The training groups did not differ statistically from each other. For solution quality, the Knowledge Only training group performed the best. Both the Knowledge and Practice and Practice Only groups had marginally higher solution quality ratings than did the Control group.

The knowledge component stands out as important for training creative problem solving. The information outlined in the knowledge programs provided participants with an explanation of which criteria are important when examining real-world problem solutions and perhaps provided enough training to increase performance.

The Knowledge Only group performed the best on solution quality. The condition expected to differ from the Control group on solution quality, Knowledge and Practice did not differ. When examining solution originality, the only group that did differ statistically from the Control group was the Knowledge and Practice group. This finding suggests that individuals receiving both Knowledge and Practice may have focused on solution originality at the expense of solution quality. Participants in the "complete condition" were the only participants who received both information about the role of originality in creative problem solving as well as practice strategies to increase originality during problem solving. Individuals found it easier to incorporate the quality component into their schema of solving real-world problems than to incorporate the originality component. One participant stated,

> I am also confused to the goal of the training. Is creativity more important than being realistic? Being realistic limits creativity a great deal and naming the training "creative problem solving" looks misleading. Maybe "useful problem solving" could be better.

The originality aspect of creative problem solving was not a focus in the Knowledge Only program. Although the concept was mentioned as a part of creative problem solving, no practice tasks on how to integrate the originality factor into real-world problem solving were provided. Individuals view quality (realistic and appropriate) as the essential factor necessary for real-world problem solving.

Overall, the training program was successful for increasing creativity skills. Both knowledge and practice components appear to be important for training. Because the results for the combined knowledge and practice groups did not consistently work the best, it may be necessary to assess how much knowledge and practice trainees need on each stage of the creative problem-solving process before training, and then to focus the training on those aspects or stages in which the trainee needs improvement.

Future research should examine the influence of training creative problem solving while using the same problem throughout the stages. Use of the same problem would improve the realism of the training. For example, managerial problems could be generated by a survey of managers and used throughout the training. Also, the present study did not examine transfer of training issues. The focus of the present study was to test the effectiveness of a specific training program; however, considering similarity of the training environment and the work environment, degree of relatedness of the training content to the job content, and organization-wide reinforcement and support of creative problem solving are essential considerations.

This research began with a question, “Can an organization realistically expect to train their employees to be creative?” Although specific considerations must be taken into account, it is possible to train individuals to make creative decisions.

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Table 1

Correlation Among Pretest and Posttest Variables

	1	2	3	4	5	6
1. Pretest Creativity	1.00	.40**	.86**	.44**	.85**	.27**
2. Posttest Creativity		1.00	.48**	.89**	.19*	.89**
3. Pretest Quality			1.00	.51**	.46**	.35**
4. Posttest Quality				1.00	.23**	.55**
5. Pretest Originality					1.00	.11
6. Posttest Originality						1.00

** $p < .01$. * $p < .05$. [a] $p = .053$.

Table 2

Correlations of Metacognitive Awareness and Self Efficacy with the Dependent Measures

	Metacognitive Awareness	Self-Efficacy
Posttest Creativity	.08	.04
Posttest Quality	.06	.02
Posttest Originality	.09	.05
Metacognitive Awareness		.51**

**$p < .01$.

Table 3

ANCOVA for Solution Creativity – Training vs. No Training

	df	MS	F	p
Pretest Solution Creativity	1	14.29	17.61	.00
Metacognitive Awareness	1	2.19	2.70	.10
Self-efficacy	1	1.15	1.42	.24
Training/No training	1	5.27	6.49	.01
Error	113	.81		

Note. Training n = 89; No Training n = 29. Training M = 3.18, No Training M = 2.66.

Table 4

ANCOVA for Solution Quality – Training vs. No Training

	df	MS	F	p
Pretest Solution Quality	1	29.78	32.52	.00
Metacognitive Awareness	1	1.53	1.68	.20
Self-efficacy	1	1.29	1.41	.24
Training/No training	1	5.51	6.02	.02
Error	113	.92		

Note. Training n = 89; No Training n = 29. Training M = 3.02, No Training M = 2.49.

Table 5

ANCOVA for Solution Originality – Training vs. No Training

	df	MS	F	p
Pretest Solution Originality	1	1.10	.89	.35
Metacognitive Awareness	1	2.00	1.62	.21
Self-efficacy	1	.35	.28	.60
Training/No training	1	5.74	4.65	.03
Error	113	1.24		

Note. Training n = 89; No Training n = 29. Training M = 3.34, No Training M = 2.81.

Table 6

ANCOVA for Overall Solution Creativity– KP vs. K vs. P vs. Control

	df	MS	F	p
Pretest Solution Creativity	1	14.58	17.73	.00
Metacognitive Awareness	1	2.08	2.53	.11
Self-efficacy	1	1.01	1.23	.27
KP/K/P/ Control	3	1.90	2.31	.08
Error	111	.82		

Note. KP n = 29; K n = 30; P n = 30; Control n = 29.

Table 7

Pairwise Comparisons for Overall Solution Creativity – KP vs. K vs. P vs. Control

	M	1	2	3	4
1. Knowledge & Practice	3.18		-.07	.10	.52*
2. Knowledge	3.26			.17	.59*
3. Practice	3.09				.42[a]
4. Control	2.66				

Note. KP n = 29; K n = 30; P n = 30; Control n = 29. Mean differences reported.

** $p < .01$. * $p < .05$. [a] $p = .094$.

Table 8

ANCOVA for Solution Quality– KP vs. K vs. P vs. Control

	df	MS	F	p
Pretest Solution Quality	1	29.47	31.82	.00
Metacognitive Awareness	1	1.75	1.89	.17
Self-efficacy	1	1.23	1.32	.25
KP/K/P/ Control	3	2.05	2.22	.09
Error	111			

Note. KP n = 29; K n = 30; P n = 30; Control n = 29.

Table 9

Pairwise Comparisons for Solution Quality– KP vs. K vs. P vs. Control

	M	1	2	3	4
1. Knowledge & Practice	2.93		-.21	-.05	.45[b]
2. Knowledge	3.14			.15	.65*
3. Practice	2.98				.50[a]
4. Control	2.48				

Note. KP n = 29; K n = 30; P n = 30; Control n = 29. Mean differences reported.

*$p < .05$. [a]$p = .066$. [b]$p = .088$.

Table 10

ANCOVA for Solution Originality– KP vs. K vs. P vs. Control

	df	MS	F	p
Pretest Solution Originality	1	.95	.75	.39
Metacognitive awareness	1	1.38	1.11	.30
Self-efficacy	1	.21	.17	.69
KP/K/P/ Control	3	2.41	1.94	.13
Error	111	1.24		

Note. KP n = 29; K n = 30; P n = 30; Control n = 29.

Table 11

Pairwise Comparisons for Solution Originality– KP vs. K vs. P vs. Control

	M	1	2	3	4
1. Knowledge & Practice	3.51		.17	.32	.69*
2. Knowledge	3.34			.16	.52[a]
3. Practice	3.18				.36
4. Control	2.82				

Note. KP n = 29; K n = 30; P n = 30; Control n = 29. Mean differences reported.

*$p < .05$. [a]$p = .083$.